is less likely that it exercises a similar influence on the visits of Odontopus. It may be suggested that pollination was once mainly effected by insects in search of nectar, and that the relations which now exist between the plant and Odontopus have been more recently established. This is the more probable, since this insect is so widely distributed in regions where Welwitschia does not occur. Possibly the coloration of the bracts at the time of pollination is also connected with the process. Certain it is that before the micropyles appear above the bracts the latter are green, and the red colour appears about the time of pollination. Further, there is no trace of a red colour in the many old specimens of seeding cones that I have examined, but I have not been able to make sure that the colour disappears while the cone is still attached to the plant, though I believe this to be the case. If this is so, the occurrence of yellow seeding cones in Hereroland specimens (as described by Pechuel-Lösche) is at once explained.[1] The native in this picture (Fig. 3) is a Herero. The shrubs in the middle distance are Sarcocaulon sp.

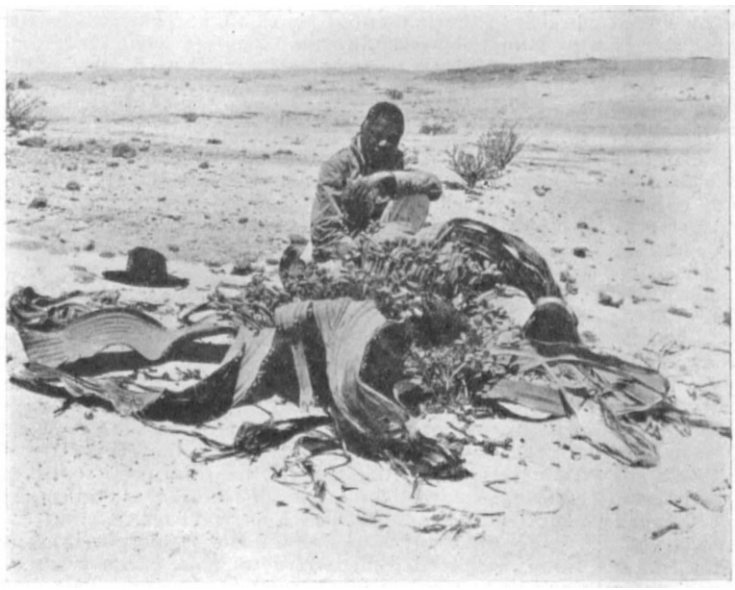

FIG. 3.—Welwitschia: Female Plant.

Through the kindness of Mr. K. Dinter, whose name is well known in connection with the botany of Damaraland, I was able to examine a bed of seedlings in the nursery of the forest department at Okahandya. The seeds were sown in July last in a deep, well-drained, sandy soil, and germinated in about two weeks. A specimen which I was allowed to take up on February 7 had an exceedingly slender tap-root with a few short branches; the main root (the tip was left in the ground) measured 20·5 cm. below the feeder, the oldest branch being 11 cm. below the same level. The fairly stout hypocotyl was 2 cm. long, the foliage leaves 4·5 cm.; the cotyledons were dry and shrivelled, and the lateral cones represented by small, vertically placed green lamellæ. The comparatively rapid elongation of the root, altogether out of proportion, on the one hand, to its own growth in thickness, and on the other to the increase in size of the aërial parts, points to the existence of a supreme necessity that the absorbing root should reach an underground source of water and as soon as possible render the plant independent of the very scanty and infrequent supply at the surface. In nature the conditions which would induce germination, and at the same time enable the root to penetrate the surface layers to a sufficient depth, must very rarely occur, and it is not surprising that young seedlings have been searched for in vain. This apparent failure of natural reproduction by seed in recent years, when considered in relation to the large number of plants found within a comparatively small area and their obviously slow growth, suggests that the life-conditions now prevailing in this Welwitschia area are more severe than formerly. There is other evidence also pointing to the same conclusion. Vegetative reproduction being entirely wanting, it is difficult to escape the conviction that, with the continuance of existing climatic conditions, the species, here, at least, is approaching extinction.

I am very deeply indebted to His Excellency Herr von Lindequist, Imperial Governor of German South-West Africa, and to Herr Regierungsrath Dr. Hintraeger, Acting Governor, through whose kindness every assistance which the Government could possibly give me in the study of Welwitschia, and in a subsequent journey further inland, was most generously afforded.

H. H. W. PEARSON.

[1] *Cf.* Eichler, in Engler and Prantl, "Pflanzenfamilien," ii., 1, p. 124 (footnote).

THE ART OF EMBALMING IN ANCIENT EGYPT.[1]

PROF. ELLIOT SMITH has applied to the study of mummification the accurate and thorough methods of observation which have won for him a foremost place among the younger generation of anatomists, the result being an authoritative memoir, which will serve both the expert and the uninitiated as an excellent introduction to the art and significance of embalming as practised in ancient Egypt. As professor of anatomy in the medical school at Cairo he has free access to the material necessary for a first-hand study of the subject. So well has he pieced his evidence together that one obtains on reading it a very complete picture of the actual process employed by the embalmers during the twenty-first dynasty. The memoir is based on a study of forty-four mummies of priests and priestesses of Ammon, belonging to that dynasty.

Although the chief object of the author was to unravel the details of the embalmer's art, he carefully collected all evidence which might throw light on the significance of a custom which was practised for a period of at least two thousand years in Egypt—from the seventeenth dynasty until about 600 A.D. During the twenty-first dynasty, embalming culminated in an elaborate technique which aimed at preserving the integrity of the skin and restoring the living form to the body. In explanation of the elaboration of technique during this period, Elliot Smith brings forward a suggestion of Dr. Reisner (in charge of the Hearst Egyptological Expedition of the University of California), namely, that the procedure had as its object a life-like preservation of the body so that it might serve as an abode for the *Ka* or "double," in place of the statue which was usually placed in the tomb along with the dead body to

[1] "A Contribution to the Study of Mummification in Egypt." By Prof. G. Elliot Smith. Pp. 53+plates. Mémoires présentés à l'Institut Égyptien et publiés sous les auspices de S. A. Abbas II., Khédive d'Égypte, Tome v., Fasc. i. (Cairo, 1906)

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answer this purpose. Whatever the object may have been, there can be no doubt as to the tedious and complicated nature of the means employed.

Before the twenty-first dynasty, the process of embalming resulted in a mummy which was simply a skeleton wrapped in a wrinkled covering of shrivelled skin. In this dynasty, or at the close of the twentieth, the process of packing or "stuffing" was introduced to avoid the shrivelling of the flesh and distortion of the body which marred the work of the older embalmers. The mortal flesh was replaced by subcutaneous packings of durable material such as mud, sand, lime, and sawdust, with occasionally an addition of aromatic vegetable substances such as onion. The eyes of the great Rameses IV. were replaced by onions. After the twenty-first dynasty, the art of embalming declined. Subcutaneous packing was discontinued, the surface form of the body being restored by swathing the limbs and body by an artistic application of bandages; later still all distortion was hidden by a free application of pitch and bandage to the shrunken trunk and limbs.

In the course of his investigations, Elliot Smith was able to verify certain statements made by Herodotus and by Diodorus Siculus concerning the methods of embalming employed by the ancient Egyptians. Herodotus describes the extraction of the brain through a small opening made on the roof of the nasal cavity—a procedure which Greenhill characterised as "amusing and impracticable." It was found that all the mummies belonging to the seventeenth and later dynasties showed clear evidence of the truth of the ancient description; early in last century, T. J. Pettigrew also verified it. In the writings of Pettigrew and in Brugsch's translation of the Rhind Papyri, the author of the memoir found much that assisted him in re-constructing the details of the process used by the embalmers. Broadly speaking, there were three stages: (1) the viscera were removed from the body through a wound in the left flank, the heart being invariably left in the trunk; (2) the body was then placed in brine for a period of thirty or forty days; the viscera were preserved in a similar medium within the four "Canopic Jars," each of which was dedicated to one of the four children of Horus; (3) after removal from the salt bath the body, now much shrunken, was packed; from the arrangement of the packing, Elliot Smith found it possible to tell the exact manner and order in which this had been accomplished; it is unnecessary here to mention the details, but one may safely state that these ancient embalmers must have had a very considerable knowledge of the anatomy of the human body.

The process of packing was finished by returning the contents of the four canopic jars to the body cavity; they were arranged in four packages, and were usually replaced within the cavity in a certain definite order. In each package it was the custom to enclose the image of one of the four children of Horus —"funerary genii," as they are named in this memoir.

The following statement of Pettigrew is quoted in this connection:—

"To Amset were dedicated the stomach and large intestines; to Hapi the small intestines; to Smautf (Tuamâutef) the lungs and heart; and to Kebhsnuf the liver and gall bladder."

On this Prof. Elliot Smith makes the following commentary:—

"The examination of a still larger series of mummies of this period (twenty-first dynasty) has convinced me that, in spite of frequent irregularities, a definite association was intended—but the guardianship of the various Genii is by no means identical with that suggested by Pettigrew. Thus the human *Amset* is usually found wrapped up in the *liver* instead of the stomach and large intestines, the ape-headed *Hapi* is usually associated with the *left lung* rather than the small intestines, the Jackal *Tuamâutef* with the stomach . . . and the hawk-headed *Kebhsnuf* . . . in the parcel of intestines."

There are many other points in this memoir which are deserving of notice, but enough has been said to show its value as a real contribution to our knowledge of the ancient Egyptians.

ASTRONOMICAL REFRACTION.

WHEN a ray of light passes through a medium of uniform density, the path described is a straight line. Should this ray meet obliquely another medium of different density it is bent or refracted. If the second medium is more dense than the first, then the ray as it enters the second medium is refracted towards the normal, or that line at right angles to the tangential plane at the point where the ray enters the second medium.

In the case of astronomical refraction, the light, say, from a star, passes through space and then penetrates the earth's atmosphere, a medium which is in all parts denser than the space between the star and the upper limit of the earth's atmosphere. By the time the ray reaches the observer it will therefore be considerably bent towards the normal. If our atmosphere were homogeneous, that is, if it were of equal density throughout, the star's light would pass in a straight line from the point where it first penetrated it to the observer's eye. We know, however, that our atmosphere is far from being of uniform density, and one has not to climb a mountain or ascend in a balloon very high before this fact is made plain.

Up to a few years ago little was known with certainty about the physical conditions of the upper atmosphere, except the broad idea that the air became less dense the greater the distance from the earth's surface, and that at the same time the temperature readings were lower and lower.

This limited knowledge of our atmospheric conditions rendered it necessary to make some assumptions as to the law of decrease of density. This was imperative, because it was of vital importance to astronomers and mariners to know how much the ray of light from a celestial object had been bent after it had penetrated our aërial envelope. In fact, what was required was the difference between the apparent and actual direction of the heavenly body in the sky.

The assumption finally made was that the atmosphere consisted of a series of concentric spherical layers the common centre of which was the centre of the earth. Each layer was considered of uniform density, and these densities or temperatures and refractive powers all decreased as the surface of the earth was left behind, the amount of decrease varying in a prescribed way and agreeing in the main with the actual, but few, observations made in balloons and on mountain tops. On this assumption, then, the ray which entered our atmosphere was always meeting with denser and warmer layers of air, and gradually becoming more and more bent as each consecutive layer was passed through.

During the course of the last few years very rapid strides have been made in investigating the upper air by means of manned and unmanned balloons and kites carrying meteorological instruments, and eleva-

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